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Camouflage for troops of the line

Army War College (U.S.)

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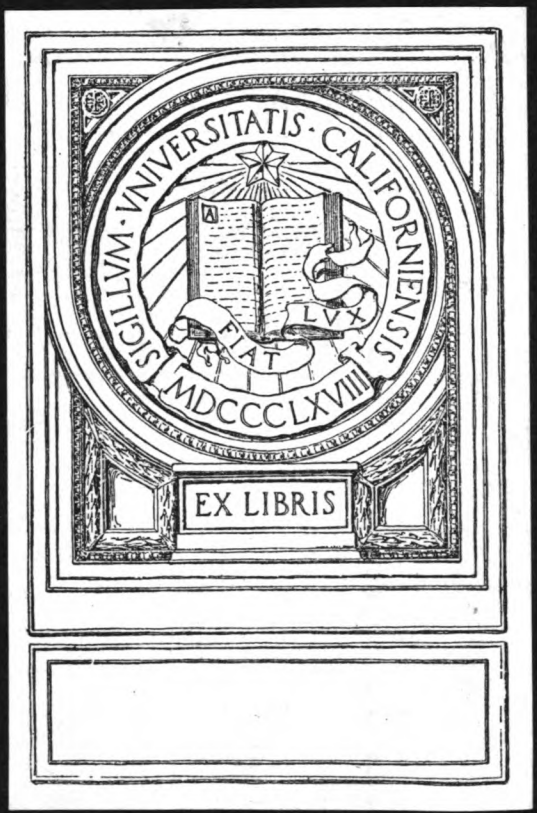
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CAMOUFLAGE

FOR

TROOPS OF THE LINE

U.S.

EDITED BY THE ARMY WAR COLLEGE

January, 1918

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G. F. P.

WAR DEPARTMENT,
WASHINGTON, *January 3, 1918.*

The following notes on "Camouflage for Troops of the Line" are published for the information of all concerned.

[062.1, A. G. O.]

BY ORDER OF THE SECRETARY OF WAR:

TASKER H. BLISS,
General, Chief of Staff.

OFFICIAL:
H. P. McCAIN,
The Adjutant General.

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CAMOUFLAGE FOR TROOPS OF THE LINE.

INTRODUCTORY.

Under the head of camouflage may be included all precautions taken to render positions and moving objects of military importance less visible. These precautions are by no means limited to work done by specially organized camouflage troops, but every command must think and operate independently to lessen its visibility and to render its movements or positions less easy to range. The subject naturally divides itself into two separate heads:

First. Concealment.

Second. Camouflage discipline.

Neither is of value without the other.

I. CONCEALMENT.

The feature of camouflage work which is most generally discussed and widely known is concealment. It may be accomplished in any of the three following ways, as the case may demand, but will usually be accomplished by a combination of two or all three of the methods:

(*a*) *Frank screening of the object, which hides the object, although the screen itself is obvious.*—This should only be employed where the extent of the screening is great by comparison with the object concealed. Example: Roads may be covered for long stretches with burlap both to the sides and overhead, affording a considerable measure of security to the troops using the roads, since it is not worth while to fire continuously on a long stretch of road on the chance that some part of it may be in use.

(*b*) *Mimicry or simulation of natural objects.*—In this type of concealment the material used must appear to be part of the terrain. There is no condition where this is inadvisable except where it may be too expensive in time or labor, by comparison with the result obtained, as in the case of screens before cited. Example of proper use: Covering gun pits with cloth, wire, and earth to simulate the earth about them.

(*c*) *Concealment by distraction.*—Attention may be diverted from camouflaged objects or from inconspicuous uncamouflaged objects by

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the erection of more conspicuous objects in their neighborhood. Example: Dummy trenches dug to divert attention from camouflaged trenches.

II. CAMOUFLAGE DISCIPLINE.

This is a feature of camouflage work which has been given much greater consideration abroad than would appear to be generally known. Camouflage discipline means that the men in any position must be required to so conduct their movements that traces of their presence will not appear, and the construction of false positions will not deceive unless traces of movement appear near them. Example: A camouflaged gun position should show no tracks; a dummy gun position in the neighborhood should have faint paths leading to it and footworn places in the neighborhood.

Capt. Colby of the Belgian Artillery says:

Camouflage discipline should exist and be enforced much as sanitary discipline is enforced. The regulations are the same irksome, prohibitive type, and are particularly disagreeable to the careless soldier. They should be enforced as sanitary regulations are enforced, by instruction to the personnel, clearly demonstrating the necessity and reason for the regulations, and by a never-ceasing vigilance on the part of the officers relative to their enforcement.

Section 1.—CONCEALMENT.

The three methods of concealment mentioned in the introduction, by screening, by mimicry or simulation, and by distraction, are almost equally applicable to all classes of objects and are generally used in conjunction; but it must not be forgotten that no concealment without camouflage discipline can be successful.

CONCEALMENT BY FRANK SCREENING.

[Quoted verbatim from an English official document.]

I.—Employment of Screens.

1. Screens are employed for the purpose of concealing from direct observation—

(*a*) Roads, tracks, trenches, and areas.

(*b*) Ground which is waterlogged, where it is impossible to dig communication trenches and over which it is necessary to move troops.

(*c*) Battery positions and gun flashes.

(*d*) Work in progress and new work.

(*e*) Dumps.

They are also used for the purpose of—

(*f*) Thickening hedges which are not sufficiently opaque of themselves.

(*g*) Representing trenches.

(*h*) Encouraging the enemy to waste ammunition, by their erection where there is nothing to hide or conceal.

2. Their main function, however, is concealment, so that if the enemy fires on them without aerial observation, he can only do so on the chance of there being something behind them.

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II.—Conditions of Effectiveness.

3. To be effective, screens should fulfil the following conditions:

(*a*) *Materials and construction.*—The material should be as light as possible, for convenience of carriage; at the same time, the construction should be sufficiently strong to resist weather, and should not be liable to extensive damage by shell fire.

They must be easily repairable if damaged by weather or shell fire.

They must be capable of being made and erected rapidly.

(*b*) *Opacity.*—The whole surface of the screen need not necessarily be opaque material to insure that the screen as a whole conceals movement from the nearest hostile points of observation.

(*c*) *Invisibility.*—Whether the screens should be arranged so that they are not likely to be recognized as such, or whether it is of vital importance to render them inconspicuous, is a matter for decision in each particular case.

III.—Materials and Types of Screens.

4. The forms of screening found most suitable are:

(*a*) Wire netting garnished with grass, brushwood, or canvas strips. It may be noted that screens made of string netting interlaced with grass or brushwood are troublesome to put up and do not stand weather.

(*b*) Brushwood and tree branches interwoven on horizontal wires stretched between rigid uprights.

5. On both these natures of screens, (*a*) and (*b*), shell fire has practically no effect unless a direct hit is obtained; and even then, if they are properly constructed, the effect should be very local. They also stand the weather well. Grass screens, however, when dry are somewhat inflammable.

6. Brushwood is probably the best natural form of screen. It has no straight edges, harmonizes with most surroundings, and is easily repairable. When it fades or dies it can be thickened up.

7. Other forms of screens employed are:

(*c*) *Complete canvas or burlap screens.*—These in certain cases are necessary, e. g., to hide flashes or movement at close range (up to 2,000 yards).

Such screens are highly susceptible to damage by weather and shell fire, must be extra firmly supported and, if possible, backed with wire netting. Wind has naturally a considerable effect on them.

(*d*) *Jute screening* (*a generic term for cocoanut or jute matting*).—This in single thicknesses is transparent; used double it forms an excellent and quickly constructed screen. The mesh is about one-fourth inch. It is useful as a temporary expedient, but does not stand the weather well. It should always be reinforced with longitudinal wires.

It has been employed with good results for horizontal screening, to conceal machine-gun nests, entrances to deep dug-outs, etc., and has been stretched over a row of huts of an advanced headquarters to hide the shadows which would have revealed the huts in an aeroplane photograph.

Tobacco shade cloth is a light cotton cloth much used for covering tobacco fields. The mesh is so open that the wind blows through freely, and the cloth is not liable to serious damage; the supports may, therefore, be lighter than those for burlap or canvas. The material will last easily three months.

8. In general, canvas and jute screens are affected much more rapidly by weather than are those made of wire garnished with brushwood and grass, and are less easily kept in repair.

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IV.—Opacity.

9. Perfect opacity under all conditions of light and background can only be obtained by the use of perfectly opaque material, such as corrugated iron. Even thick canvas is not always opaque, e. g., when the sun is low and behind it. Usually it is found sufficient to provide a screen that is sufficiently opaque under normal conditions, that is to say, one which hides movement from any but very close and continuous scrutiny.

10. The screening effect is much influenced by background and angle of view. A comparatively transparent screen may be successful if the background is of a color generally similar to the objects to be screened, is broken by trees and hedges, or is viewed from an angle other than at right angles to its surface. There appears to be little difference in visibility between objects 20 yards and 100 yards behind a screen, though an object 5 yards behind it is more easily seen than at 20 yards.

11. Unless assisted by natural accidents of environment, it is necessary that about three-quarters of the surface of a screen should be made of opaque material, if it is to hide movement at medium ranges (2,000 to 4,000 yards).

V.—Visibility.

12. There are two distinct categories of screens:

(*a*) Those which must be obvious to the enemy as screens.

(*b*) Camouflaged screens, designed to conceal and yet to escape detection themselves.

13. These latter are either made of—

(*i*) Solid painted canvas, or wire netting garnished with strips of canvas, brushwood, grass, etc., colored in patches to present a general landscape effect, or to represent hedges.

(*ii*) Solid canvas carefully painted to reproduce a definite locality, brick wall, ruins, and such like.

14. Painted screens can rarely serve their purpose for any length of time, and only in exceptional cases (where they are not required for more than a few weeks) are worth the time and trouble that must be expended on their manufacture.

15. Their defects are:

(*a*) That the effect obtained by painting only lasts a short time when exposed to weather, and does not vary with the seasonal changes in the natural surroundings.

(*b*) That they require greater care in construction, and more maintenance, than ordinary screens, and are highly susceptible to damage by weather and shell fire.

(*c*) That it is very doubtful whether they do deceive the enemy. Should they not do so, they only perform the function of an ordinary screen, i. e., that of concealment, but have taken longer to construct.

16. It must be noticed that camouflaged screens are usually erected where they are liable to steady direct observation as opposed to the comparatively fleeting examination from aeroplanes to which camouflage gun covers are exposed.

17. The following are examples of the successful use of camouflaged screens:

(*a*) Work on exposed battery positions about 1,800 yards from the enemy's front line was made possible by the erection of screens composed of raffia on wire netting. The screens were mounted on wooden trestles, of a maximum height of 10 feet. These enabled the raffia netting to be put up at a slope and so to simulate a bank or false crest. The extremities of the screen were sloped gradually to the ground by using progressively lower trestles. Both

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front and back slopes were furnished with raffia netting, in order to get sufficient thickness to conceal flashes. The outline of the top of the screen was made to conform to the features of the landscape in its vicinity, and the slopes were gentle.

(*b*) In another instance imitation brick walls painted on canvas backed with wire netting were erected for a similar purpose.

(*c*) Imitation hedges of a combination of raffia, canvas strips, and brushwood on wire netting were made to conceal a battery position, which otherwise would have been under direct observation. In this case an existing hedge, which was in the rear of the position, from behind which the guns were unable to fire, was removed and the imitation hedge substituted for it in front of the guns.

18. It is a general experience that newly erected screens are shelled by the enemy for a short period, but that he soon gives up firing if damage is repaired persistently.

19. A good example of this is afforded by the screening of an exposed area on the British front. Over 7,000 yards of screening, consisting of hay bands interwoven in wire netting, were erected, but no attempt was made to render the screen inconspicuous. It was shelled to some extent, but any damage caused was immediately repaired. The screen five months later was still fulfilling its purpose, i. e., that of concealing what went on behind it.

20. The following are examples of the special use of clearly distinguishable screens:

(*a*) By erecting screens in front of a line on a portion of the British front, it was possible to employ large working parties by day, with the result that there was a considerable increase in the amount of work done.

(*b*) At another spot an old shattered trench was made practicable for the conveyance of wounded, although in full view of the enemy, by the erection of a screen made of raffia on wire netting fastened to pickets set at an angle of 60°. This also served to conceal the newly excavated chalk thrown up in improving the trench.

(*c*) A road was screened by utilizing the trees which had been felled by the enemy in retreat. Strong straight limbs to serve as posts were erected about every 18 feet, with 10 feet projecting out of the ground, and large branches were cut off and stuck upright between them. Three strands of plain wire were run from post to post and passed through the branches to help support them. There was a lot of dead wood about on both sides of the road. The screen was effective and was not shelled.

(*d*) While battery positions were being dug a screen was put up some 400 yards away to the left. "It afforded the enemy much amusement and usually drew 80 to 100 rounds of 4.2-inch a day from him. The battery positions were left in comparative quiet."

(*e*) A screen about 600 yards long and full 16 feet high, made of hop poles, with brown canvas strips, painted here and there with big patches of black and green, and of sewn-on widths of wire netting, which were hung from five horizontal wires, was erected to screen some guns. It was put up a month before it was wanted. The enemy shelled it for a week or two, but after breaking two poles, which were repaired at night, desisted.

21. There is no doubt if screening is carried out on a comprehensive scale, and with a continuous policy, that localities which would normally be under observation, and subject to deliberate shelling, become practically immune from it. This immunity does not depend upon the invisibility of the screens erected, but on their distribution. From ranges of 4,500 yards and under there is little difficulty in picking up the various types of screening ordinarily used. In

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every case, however, before a scheme of screening is settled, the ground should be carefully reconnoitered to be sure that every advantage is taken of its natural features, and to ensure, as far as possible, that there is assimilation of color to local surroundings and background. Straight lines are usually more easily distinguishable than broken ones, so that irregularity of the top of the screens may be of value. Some screens along a road drew fire probably because they ended abruptly instead of sloping gradually away to the ground.

22. It is advisable to consider well beforehand in the summer months what screens will be required in the winter after the leaves are off the trees, and to have them erected before the natural cover disappears.

VI.—Siting of Road Screens.

23. Roads running perpendicular to the front line are best screened by hanging vertical screens between trees or houses, or poles, across the road.

24. In the case of roads running parallel, or more or less parallel, with the front line, it is advisable, when possible, to site the screens at least 50 yards from the edge, in order that shell fire directed at the screens shall not cause damage on the road and vice versa.

25. Such road screens may require to be made specially high; but at the same time, the lower edge can usually be some distance above the ground.

26. Short lengths, of about 30 yards, placed en échelon and overlapping each other, are preferable to long continuous lengths. This method permits of plenty of passageways, and limits damage by shell fire; and further, the line of route screened, not being defined, becomes difficult to range on.

27. Roads at an angle to the front can be concealed by screens facing the front arranged en échelon.

VII.—Flash Screens.

28. Screens have been successfully used to hide gun flashes at night from the front and from a flank.

29. In one case where the flashes were visible from a flank, a long solid canvas screen (painted a dark color) was placed 50 to 100 yards on the right front of the battery. This was found difficult to maintain, and six small screens were substituted, one about 4 yards to the right of the muzzle of each gun, and running out about 8 yards to the front. They were about 8 feet high, of which only the top 6 feet were canvas. They were dismantled during the day and re-erected each night, in socketed holes.

Screens of the type above described will naturally be manufactured in depots and issued to working parties whose duty it is to erect them, generally under the superintendence of the camouflage officer, but the principles are so simple that no officer should wait for specially trained men to do the work, and if no material is issued it should be improvised.

CONCEALMENT BY MIMICRY OR SIMULATION.

Concealment of a position or of any object by covering it or coloring it to represent natural objects, while always desirable, is practicable only where the areas of objects are small in proportion to the number of men employed on their concealment.

Trenches.

It is quite generally stated that it is impossible to conceal trenches from discovery by the enemy, especially when the opposing trench systems are close together. This may be the case, but it is certainly

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possible to construct the trenches so as to make them far less conspicuous than they ordinarily are, and it is quite possible to construct trenches, the exact location of which can not be determined from the opposite front-line trenches. This will make it much more difficult to properly observe the effect of artillery fire upon a trench except by aeroplane and will make the trench a much less conspicuous mark for machine gun and rifle fire.

In the first place the parados should always be higher than the parapet, and neither should have a regular outline, for if the parapet is higher than the parados, a man's head and shoulders are silhouetted against the sky (unless the fire is through loopholes only), and he is readily observed. If the parados is higher than the parapet, a man with a sniper's helmet designed to simulate the earth in that locality can move up and down without being observed. It was found through experimental work that if the parapet and parados both be of irregular outline and covered with mats or planted with tall grass or brush, a man with a sniper's helmet, covered with grass, can not be seen, even in motion, at a distance of 30 feet. Lighting conditions, however, have a good deal to do with visibility. In trenches which are particularly important, the parapet and parados should be sodded or covered with imitation grass mats of fireproof material. The transplanting of a very few clods of turf, or the planting of quick-growing weeds, or both, will enormously decrease visibility. If a trench can be so constructed that the parapet is composed of a series of mounds, between which ordinarily defilade fire only would be possible, men in the trench would be much less liable to observation. If the parapet be irregular, machine guns can not be set to sweep it at night, nor can fixed rifle rests be set with accuracy.

New trenches in permanent positions can to advantage be dug under camouflage covering. Supports are placed on the ground, the ends extending well past the edges of the proposed trench, covered with mosquito netting, painted to the color of the surroundings, and occasionally dressed with clods of turf or earth. The trench is then excavated below, leaving the cover intact until such time as it is desired to remove it.

It is obvious that this form of trench digging can not be employed except when there is sufficient time for the trench to be excavated from a few fixed points and the dirt removed. It has advantages over a tunnel in that no artificial light is needed, and that it can be readily converted into a fire trench. Also ventilation is always good.

Overhead coverings for existing trenches can be made in a similar manner or can be of chicken wire knotted with raffia or similar material. It must not be thought that camouflage is worthless if discovered. It makes range finding difficult and spotting of artillery fire harder. It is obviously impractical to cover entire systems for

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concealment from aerial observation, but it is not impossible to completely conceal from aerial observation positions of trenches which it is especially desirable to conceal as may be seen from the captured German report below quoted:

Observations made in the three corps have shown that in the present state of our aerial photography trenches and similar works can be hidden from view only by means of a well-made screen of brush in great quantities, or by covering them completely and adapting the covering to the surroundings.

On account of the considerable labor involved and the great quantity of material necessary to produce the desired effect, complete camouflage, preventing aerial photography, can be supplied only to small works, cover for single guns, machine guns, etc.

In spite of this, it is nevertheless important to continue to require that all works be concealed from observation both from the ground and from captive balloons. Also, in my opinion, it is necessary that in all works, constructed in the rear, the earth removed be entirely blended with the surroundings.

Aerial photographs will then show the great value of simulated or dummy works.

As the French, in their recent attacks, have systematically bombarded roads of approach, it would be useful in order to disseminate the fire of the enemy to likewise make false roads of approach.

Gun Positions.

There is probably no military activity which has been so systematically concealed by all the armies engaged in the present war as the gun positions, and these are in the main concealed by the batteries themselves. Capt. Colby, of the Belgian Artillery, states as follows:

Camouflage should in general be constructed before the battery is placed, and each battery should carry with it a sufficient amount of material to roughly camouflage their positions. Of course the positions for very heavy guns must be necessarily placed some time in advance in camouflage of especially careful construction and under the supervision of camouflage men. In all light batteries the artillery men should be prepared to construct their camouflage for themselves.

Each battery should be provided with the following mobile camouflage as part of its equipment, i. e., 6 nets and 6 thin tarpaulins, for field batteries 8 yards square, for heavier pieces about 160 square yards in area and divided into convenient strips. The nets or strips should be folded, placed in sacks, and carried on the limbers and caissons as seats for the carriers. Folding umbrella-shaped supports (from 5 to 12, according to the size of the net) should be carried as well. The weight for a net, 8 yards square, is from 10 to 15 kilos. Batteries should also be issued different-colored paints as required for color camouflage.

Every battery should be provided with camouflage nets issued by the camouflage section, one net with supports being issued for each section.

These issue nets should be supplemented by tarpaulins of light burlap in broken coloration. When the battery is forced to come into position without a prearranged emplacement, it may be provisionally concealed by this portable camouflage. When time allows the emplacements should be made beforehand, under cover of the same camouflage. It should be borne in mind that, although the nets continue the general aspect of the country, they do not prevent white sandbags and new earth and particularly concrete from being visible in aeroplane photographs. It is therefore necessary to cover work of this kind with

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the burlap tarpaulins and again camouflage these tarpaulins with the nets. If nets are not available, branches of trees, grass, and bushes should be used. The nets must rest on umbrellalike supports or on poles so that they do not follow the form of the construction.

All this material can be made here in France with great rapidity and its immediate issue to batteries should be insisted on by the artillery.

For heavy guns probably the best camouflage is one which is entirely natural and this work should be completed before the batteries are placed. Nor should the batteries be placed until the commanding officer is reasonably certain, both by observation from his own planes and because of the indifference of the enemy, that the camouflage is successful.

As giving an example of faulty camouflage, we were shown an aerial photograph which was taken behind the German lines at St. Hilaire le Petit, in front of Châlons, on April 15, 1915. This photograph showed a clearing which had recently been made about 5 kilometers behind the lines, with a small field railway line leading up to it. The clearing in question was about 100 feet square. The fact of this clearing with a railway line leading to it made the French suspicious, and the point was subsequently watched very carefully. About July 1, the aerial photograph showed this clearing as well as the connecting line of railway, gradually disappearing, the Germans evidently planting trees and erecting screens to cover it. About September 1 some 6 or 8 long-range projectiles from a 380-millimeter German naval gun were fired by the Germans into Châlons, a distance of 32 kilometers from the point of this clearing. The French immediately concentrated heavy gun fire on the clearing shown by the original photograph, and artillery fire on Châlons, since that date, has stopped.

The criticism of the German camouflage in this instance is that they should not have made the original clearing, which was at once discovered, but should, on the other hand, have made their emplacement and mounted the gun after the camouflage had been erected in the position concealed. Naturally by sound ranging, the position of the gun would ultimately have been determined, but this would have taken time, and the damage in Châlons would have been much greater.

Artillery in the Open.

It has been repeatedly stated that camouflage loses its utility when open warfare is begun. From the few attempts which have been made to utilize camouflage in open warfare, it would appear that this is not the case.

Capt. Cushing Darnell, R. F. A., states:

During the battle of Vimy Ridge the first English field artillery brigade was ordered forward as soon as the Lille-Arras road had been sufficiently repaired. I met the brigade commander in Vimy Station. He selected an open field, just back of the railroad embankment, to put four of the batteries of his brigade. There were no trees or bushes within a thousand yards of the place where the guns were to go into action.

The Germans were shelling the Lille-Arras road with 5.9s, so that the brigade could only move forward after dark. I brought the battery into action at 10 o'clock on a dark, rainy night. The guns were put just back of the railroad embankment and 400 rounds of ammunition dumped beside them. The amount of camouflage possessed by the battery was limited to six strips of chicken wire 6 by 20 feet, in which pieces of painted burlap had been woven to give the effect of grass and reeds. Having used all our camouflage to cover the guns, the pits dug for the men had to be covered up by ground sheets.

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At 6.30 the next morning the German planes came over, and at 6.45 their batteries opened on the field. The battery immediately behind my battery had been careless enough to go into action without any attempt to cover up their guns with camouflage, and because of this they were spotted by the German planes and heavily shelled. Their casualties were so heavy that they had to move the battery to another position.

The position of O. P.'s for batteries in action in the open present the same opportunities for the use of camouflage. The fire of batteries in 95 per cent of the engagements to-day is indirect. With the exception of the few days of an advance immediately following a successful offensive, the field batteries can not be said to be in action in the open. The German observation from the air is so clever and accurate that the battery commander always tries to get cover over his guns at the earliest possible moment.

During the offensive in the Balkans, in the spring of 1916, it was necessary to move our battery as rapidly as the mountain roads would permit. The transport had broken down. We had no camouflage. Branches of trees, bushes, reeds from the lake shore, and bits of blankets painted in earth colors were used.

It is being strongly advised not to allow batteries to go forward in the open without a certain amount of camouflage to render their work less dangerous. A battery in the open that is not protected in any way by camouflage is bound to be shelled very heavily.

In this connection it may be said that the use of natural objects is invariably better than artificial imitation of natural objects. Paint can never completely imitate earth and may photograph in an entirely different way. And while artificial grass or painted screens may temporarily deceive, the only permanent concealment will be made from the same objects as those surrounding.

CAMOUFLAGE BY DISTRACTION.

It is obvious that if a dummy and an actual gun position are simultaneously erected and both become known, and the dummy position is well enough constructed to lead the enemy to believe that it is a real position, to destroy the real position will need twice as many shells as if it alone were discovered, since the enemy can not afford to take chances that the dummy position will be unoccupied. If only the dummy position is discovered, the actual position will be perfectly safe. Successful camouflage of gun positions or of any position which is active, can not be done by concealment alone, since the enemy will realize by sound ranging or flash ranging that there is a battery in operation in that vicinity, and if their attention is not directed to a false position, they will eventually search out the true position. One must be careful, however, in erecting a false battery or a false trench to see that it is not obviously false. The dummy position must be camouflaged on correct principles, but it must be revealed as if through carelessness of the men executing the work or through lack of camouflage discipline (of which more later). The same thing is true of trenches. At the beginning of the war both sides were content to build dummy trenches only a few inches deep and to leave them without visible signs of movement. These trenches

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were instantly discovered to be dummy; in the first place by lack of shadows, and in the second place because they did not change their configurations as do occupied trenches. On constructing dummy trenches, it is essential in the first place to make them deep enough to cast a shadow over the entire bottom of the trench and in the second place to keep altering or revising them, and if they are shelled, to repair damage. In the same way screens may be erected for no particular purpose except to draw fire which would otherwise be utilized upon important points, and if these screens can be so constructed as to arouse the enemy's curiosity and invite his attention, far more important objects may go unscathed. It is essential that false positions present the characteristics of real ones.

From Capt. Colby:

I remember two instances on this point. In 1915 we replaced a very heavy piece of artillery by a wooden imitation; no proper attempt, however, was made to conceal this piece and the enemy never fired a shot at it, although he had frequently bombarded the real gun. Last year a fake gun of large caliber was placed at a short distance from the real gun and was clumsily camouflaged. The enemy promptly counterbatteried the piece with a large number of projectiles and continued to do so.

The fake position should be made to appear to fire with visible flashes, at the same time that the real battery is in action with its flashes as far as possible concealed. Flash apparatus may easily be improvised, using the powder sacks which are discarded by the howitzers when firing with reduced charges.

The camouflage service will provide dummy guns with flash apparatus where needed.

As much of the information which the enemy possesses as to troop movement is made from indications based on aerial photographs as to the use of roads, false roads or artificial widening of old roads will distract his attention from the roads most in use. The constant passing of trucks and troops, if along a well-bounded road, will in the end widen it to a considerable extent, and it is probable that no amount of camouflage discipline will entirely overcome this tendency. On the other hand, artifical widening of roads will lead the enemy to believe that a movement in force is intended where none is actually contemplated, or that natural movement is proceeding in some direction other than the correct one. As the general location of ammunition dumps, etc., is necessarily revealed by the amount of traffic in their direction, everything which can be done to lead the enemy to believe that supplies are being brought elsewhere is of value, and this can be most readily done by false roads or by widening of old roads. Gun positions are very frequently revealed by portable railway, and as portable railway is almost impossible to entirely conceal, camouflage by distraction must be resorted to.

As giving another example of a somewhat similar case, where the camouflage idea was effectively carried out, the French made arrangements to place a large caliber gun in position at a certain point. For this purpose, they made a

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clearing for a narrow-gauge railway, 1,500 meters in length. Of this distance only 700 meters of iron track was put in. The balance of the clearing was tracked with wooden rails. From the end of the iron rails a branch line, 300 meters in length, was constructed at right angles through the clearing, covered with camouflage screening, and at the end of this latter line the gun was mounted. When the firing of the French piece began, the Germans at once opened fire in the vicinity of the end of the wooden track and the actual position of the gun was not determined by the Germans. This is an example of proper camouflage precautions.

Section 2.—CAMOUFLAGE DISCIPLINE.

Much work which is admirably concealed is discovered and destroyed because its presence is revealed by tell-tale movements recorded upon the earth and plainly observable in aeroplane photographs, and it is absolutely necessary that all troops should be informed of the necessity and value of care in walking about or in moving vehicles.

The head of the British Military Mission stated that the principal difficulty with camouflage in the English Army was that the men did not take the trouble to use it, and a very great proportion of English casualties was due to the carelessness of the men in this respect. A captured German report signed by Schott, Lieutenant of Reserve, 32d Feldfliegerabteilung, treating of the hiding of artillery implements from aeroplane observation, states as follows:

(*a*) Batteries best sheltered from observation are found along roads. Cross-roads lend themselves to this best; there the shelter of the piece will be notched in banks. The notch can be covered with planks and earth. All traffic is revealed very clearly upon photographs of artillery positions in the open by the clear tracks resulting from the passage of wagons and troops in place of, in this case, on an already existing road.

From this it results that—

(*b*) The installation of batteries on slopes in terraces is likewise very favorable. But in this case it is necessary to note that the transport of the battery should not operate perpendicular to the direction of the slope, for the abrupt termination of the wheel traces along the slope always reveals an artillery position.

It is preferable that all circulation takes place directly behind the slope and in its direction. In most cases it will be difficult to distinguish on the photograph the wheel tracks from the shadow of the slope.

(*c*) Most often artillery is revealed by the radiating tracks. Tracks which end abruptly in a fan shape are clearly discernible on photographs. At each track end there appears clearly an emplacement in semicircular form. From this it results that the approach roads should be effaced to at least 300 yards in rear by means of plowing and harrowing. At the end of the existing wagon road is installed, as often as possible, a false battery with radiating wheel tracks. The foot path leading from the false battery to the position occupied need not be direct in any particular case.

Organization of Dummy Batteries.

It results from the preceding that on photographs false batteries are, at the first glance, easy to distinguish from positions, when it is considered sufficient to simply build the false emplacements and leave as it is the surrounding ground, especially behind the position, as happens so frequently, so that the false position appears on the photograph to be deprived of movement. That is why it

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is strictly necessary that behind every false battery tracks should be kept fresh by making the supply trains pass over them from time to time, as often as possible, preferably after a rain, and in a direction well considered, according to an established plan.

A haphazard circulation of traffic behind the position without following a predetermined road does not deceive the adversary sufficiently.

A French report reads as follows:

Tracks.

Aside from cannon and machine guns entirely sheltered in trenches, the whole defensive organization of an army is visible. The first thing that is noticed on a photograph is the tracks. The number, their direction, their ramifications, their points of departure and arrival give many valuable indications. They end at revictualing points, batteries and communicating trenches. By their number and their importance they give an idea of the life of a sector; they reveal the activity of a battery and the traffic at a revictualing point, etc.

On a panoramic photograph, the ensemble of tracks shows very well the extent of the different sectors, and enables one to determine them (the sectors). The suppression of tracks is, therefore, of vital importance. It is necessary to distinguish between two sorts of tracks: those followed by men and those traveled over by wagons.

The most simple means of avoiding tracks made by men is to make them follow the borders of cultivation, the perimeter of fields. Indeed, every path which cuts across one or more fields in any direction strikes the notice of the observer, and in following its trace the observer arrives at the work which it serves. On the contrary, a path which follows the limits of fields, turning at the angles without rounding off where fields overlap, will not show up on a photograph. If the maps that are used for the identification of the photograph show the limits of the fields, it will be extremely difficult, if not impossible, to discern whether or not such a path is prior to the date of occupation by the troops.

In order to retain the vertices and the angles of the fields, a few low pickets help to guide the men. In regions where sand does not permit cultivation, this treatment is evidently impracticable, but on account of its very nature (rocks, stones, etc.) paths do not leave traces.

In the case of a short covering of grass it is necessary to trample soil over a large area, indicating the path by pickets. The tracks made by wagons have, in general, only a limited width. It would then be necessary, for these short distances, to cover the ground (following always, by preference, the limits of fields) with a flooring of planks having irregular edges painted the color of the field. One could thus cover the path with stones and sand, widening it out up to one edge of cultivation in order to give it the appearance of a separate piece of terrain. Restrict the routes and paths to get to watering places or to rivers in order to avoid tracks.

Batteries.

Even after a battery emplacement has been located on a photograph, or by aerial observation, it is very difficult, if not impossible, to know whether or not it is occupied, or whether or not the pieces that can be perceived there are false. It is then obvious that dummy guns will be placed everywhere where there is an unoccupied or abandoned battery emplacement.

The things that show that an emplacement has been recently occupied are: (1) The erosion of the soil in front of each piece, the erosion due to the blast of the cannon during fire; (2) the freshness of tracks leading to the pieces.

The erosion of the ground in nearly all localities is manifested by a white speckled spot in front of the mouth of the piece. By spreading iron dust

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on the ground that is thus stirred up, it will be impossible for the observer to tell what it is. The photograph will be equally silent. Another method consists in paving with bricks or cement the part exposed to the blast in front of the mouth of the cannon, this coating being painted the color of the surrounding ground. Suppress paths.

It is hardly necessary to supplement these quotations. They are sufficient to prove that camouflage discipline is as valuable as concealment. The chief of the British aerial photographic section states that in the case of photographs taken at great heights the nature of objects is rarely discernible from the photograph of the object. It is generally discovered by indications on the surrounding ground, of which the principal are tracks or paths. A French artillery officer says that no battery commander should ever permit trucks to turn around directly opposite his position. He was asked whether a sentry should be posted to enforce this regulation. He replied, "Some people use sentries; me, I use a little piece of barb wire."

Section 3.—SPECIAL CASES.

BUILDINGS AND SHADOWS.

The camouflage of buildings from horizontal observation is a problem for the trained camouflage forces, and buildings which are of any military importance and which are in view from the front, either from observation posts or from kite balloons, will not long exist. Buildings which are protected from direct observation will be discovered only by means of aerial observation and are revealed chiefly by their shadows. Buildings should, therefore, be located as far as possible either where they will cast no shadow, as on the north side of steep hills or high banks, or where their shadows will be broken by tree shadows. It follows then:

The siting of buildings is the most important element in their camouflage, for it can be regarded as practically impossible to conceal buildings from aerial photograph unless their shadows may be concealed. No satisfactory method of eliminating shadows has yet been found. This should be very carefully remembered by engineer officers in charge of construction.

Since construction can not be done instantly, it follows that all buildings are liable to be discovered before they are camouflaged. But this does not destroy the importance of camouflage, especially against bomb dropping, since a building may be accurately located on a map and still difficult to discover from the air. It is suggested that in order that the time that buildings are exposed to observation may be as brief as possible, that ready painted roofs be used, that the roofs be constructed as early as may be, and the balance of the construction finished later, or that portable buildings be used wherever possible. It must be remembered that aerial observation is not dependent upon a single photograph but that photographs made at intervals of, say, 60 feet, and examined through a stereoscope magnify the apparent height of a building from 8 to 10 times. The buildings should, therefore, be reduced to the lowest possible vertical dimensions; all shadows from cornices or eaves should be suppressed;

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regular outline should be eliminated as far as may be, and artificial silhouettes should be applied to the edges of roofs in order to cast irregular shadows and therefore confuse the observer. A French suggestion is to color the ground on which shadows are cast, dark, with broken patches of black or dark color upon the roofs. This may sometimes be of assistance and should not be neglected, but no color is as dark as shadows and will not always be effective.

The coloring of roofs and of buildings in general should simulate the natural colors of the surrounding country as viewed from a height of not less than 3,000 feet. Aerial observation should accompany every important camouflage work. Where it is impossible to site buildings so that their shadows will be concealed, it is desirable to represent them as being something else from what they are. A French report before quoted states that they should be built to simulate groups of cottages or farm buildings.

Buildings.—Buildings of large size and hangars can be made up by painting the roofs red if in a region where the roofs are covered with tile, slate, or straw color, according to the locality. False windows and false doors can be painted on walls whitened to give them the appearance of houses.

To divide the construction to the eye so as to mask its importance, a part of the hangar will be painted white with a red roof and green shutters. For example: Another yellow, with dark-red roof and brown shutters, etc.

In order to give them complete illusion of occupied houses, it would be quite possible to outline artificial gardens with false hedges, false clumps of flowers made with little hillocks of earth. Little walks can also be outlined.

Heavy guns can be placed in these buildings disguised as peaceful houses. As for little buildings, make them always with roofs having a single slope conforming to the lighting so as never to have one side in the shade. Zigzag the outline of the roof in order to avoid straight roofs. In the case where oblique photographs[1] could be taken, put a hedge or branches against the highest face of the building so as to give irregularity to the wall. Make these buildings as low as possible.

Shelters for aeroplanes dug in the ground are long and difficult to establish. Hangars disguised and distant from one another should therefore be the rule. The open side of a hangar will be placed to the north so as to be always in the shade. If oblique photographs are taken, this gable end in the shade will not reveal an opening.

PROTECTIVE COLORATION.

The principles of protective coloration were first discovered by naturalists, who found that animals and birds were colored so as to blend them with the background and thus protect them against the animals which preyed upon them, and to conceal them from the animals on which they preyed. All objects of military importance, therefore, which can not otherwise be concealed should be protectively colored so as to render them less visible from the points from which they may most probably be observed, whether from aeroplanes, kite balloons, observation posts, or the ground.

The most effective means of protective coloration is to render them similar in tone and color to natural objects, and to destroy their

[1] By this is meant the stereoscopic photograph before described.

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shadows. Any object that in part is in the shadow cast by itself and which is liable to be observed from about its own height should have the lower part painted very light; in the case of a circular object, such as a cannon, the bottom third should be painted white, and the upper third darker than the surroundings. This painting should never be regular but should be blotched in blotches of a size to be determined by the probable distance from the observer. Since all natural scenery is a combination of color and shadow, it is essential to color a flat, artificial object with blotches which simulate the tones and shadows of nature. It is also desirable to destroy the expected outlines by blotches of color. A square box, for example, can be made to appear other than square by blotching corners and angles in such a way as to blend with the shadows of the sides, making the actual form difficult to determine.

All railroad cars, wagon covers, wagon bodies, guns, and gun limbers, tanks, auto trucks, and the like should be painted in irregular splotches so that the familiar grouping of shadows and colors of these objects are lost, since we recognize objects by a recollected assemblage of light and dark spots. The English trench helmets, even, are painted in irregular daubs to match up with the colors of the trenches against which they appear. In spite of the fact that camouflage by color alone is becoming of less and less importance as the opposing armies have learned to recognize camouflage painting, its use is still desirable, and should not be omitted. Although guns are rarely in action without an overhead covering, they may still be visible through this covering and may be discovered if their color is uniform. Trucks by a roadside can not be readily seen from aeroplanes if their color is sufficiently broken to blend in with the landscape. As single patches of color they are plainly visible.

PAINT AND PHOTOGRAPHY.

It is extremely important and it can not be too often repeated that all objects of military importance should blend with the landscape, and where it is only possible to do this work with sufficient rapidity and durability by use of paint, paint must be used, but natural objects are invariably preferable to painted imitations of natural objects for this reason:

Paint may not appear on the photographic plate as it does to the eye, and a very successful ocular simulation may be absolutely unsuccessful in a photographic plate. No paintwork should be done except after thorough experimental photography of the colors intended to be used. The photographic plates now in common use by the Allies, and probably by the Germans, are orthocramatic and panchromatic, and while the results in the panchromatic plates approximate the color values more closely than those on the orthocramatic plates, by the use of special filters photographs of painted objects are apt to appear completely different from natural objects.

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Another reason for the use of natural objects is that paint does not change with the season, so that while natural colors are constantly being altered, artificial colors remain fixed and become apparent. Therefore, no camouflage work which can possibly be done by mud, dirt, foliage, shrubbery, or other natural objects should be painted.

GUN EMPLACEMENTS AND MILITARY WORKS.

No military work which can be of irregular shape should be of regular shape. Every military work should be reduced to its least possible dimensions, especially in the direction of height. In every covered gun emplacement when the covering is raised to give command, the slopes should be easy and natural, growing from the surrounding terrain as if by accident and not by design. When several gun emplacements are near together, they should be covered by a single irregular mound instead of by a group of small mounds. As the importance of a position may be determined from the amount of excavated earth which surrounds it, it is therefore desirable to transport all earth to a distance. Nor should natural material for camouflage covering be secured in the immediate neighborhood of the work to be camouflaged. A number of German gun positions, otherwise very carefully camouflaged, were discovered because the cut turf was noticed in the territory immediately surrounding them and the entire locality was heavily shelled. As there is constant comparison of photographs, any disarrangement is at once noted, and if it leads to the security of a battery position the waste of ammunition by the enemy is doubly successful.

Trenches constructed in the rear of old positions should be completely covered in order to remain undiscovered. Screened or movable coverings for loopholes should alone be used, with minute observation openings. Wire entanglements should never have symmetrical outlines, and galvanized wire should not be used for entanglements where plain iron wire can be obtained. Posts should be painted in broken colors to simulate the earth or background as seen from the enemy's position. Iron pickets for wire entanglements are greatly preferable. It is desirable to omit the command of machine-gun emplacements altogether, strong bomb-proof shelters being provided and machine guns set up in the open when necessary.

RAILWAYS.

Railways of standard gauge are practically impossible to conceal, but the roadbed should not in appearance be carefully kept up. They may be so sufficiently disguised by grass or weeds, either permitted to grow or artificially planted, that it will be difficult to range artillery fire upon them, and if they are used only at night, and are of sufficient importance to warrant the trouble, artificial trees or buildings or even low canvas mounds connecting the crests of hills at each side of cuts, or artificial shell holes made of canvas, may be moved upon them at daybreak, to remain until a free track is desired.

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Narrow-gauge roads should follow the edges of roads or hedges bordering fields or other similar artificial lines. If it is necessary to cut across fields as it sometimes happens one part of the field should be plowed in a different direction from the other and a hedge planted alongside the road. The railroad will thus be confused with the border of the imitation field.

Revictualing points reveal themselves to the aerial observer by converging paths or ways toward the railroad. These points should preferably be established in farmyards or at other similar places where trampled condition of the ground already exists.

OBSERVATION POSTS.

Observation posts, especially for the artillery observer, will be in general armored cupolas prepared and erected by the camouflage section. The artillery officer selecting the position of these posts should remember that the artificial positions must be made to blend with natural surroundings. In the case of forests steel observation trees have been made and used with success by both sides. Capt. Cushing Darnell, R. F. A., states that in the 1917 spring offensive there was a clump of trees by the German front line which was regarded with suspicion by the British Infantry. They discovered that one of these trees was probably a camouflaged tree.

Quoting from Capt. Darnell:

> I got two batteries into the clump of trees. When the camouflage tree was knocked down, a working party of Germans tried to rescue the observer, with the result that they had about 15 casualties in 2 minutes and had to abandon the camouflage tree with its contents to the tender mercies of the machine guns and snipers in the front line. In this particular case the tree was not over 50 yards from the front line and had probably been in use for some weeks.
>
> Our engineers tried to construct a similar tree. No sooner was it erected than a regiment of Saxons in the German trenches opposite stuck up a large signboard on which was written in English, "For God's sake, take that damned thing down."

Trees of this kind must be of good size and must be covered, modeled by a capable sculptor over the metal, and covered with imitation bark. Artillery officers should therefore select a clump of trees which includes one which could be cut down and replaced by an artificial tree of similar dimensions. Observation posts in Flanders are most commonly located in ruined houses or factories, and suitable openings for observation may be made by removing stones, tiles, or rafters and replacing them with hollow stones, tiles, or rafters with slits for observation. Even an elevated piece of ground may be used for an observation point if a single lump is large enough to give command and not too large to be replaced by an artificial lump of the same color, size, and form. Even the bodies of dead soldiers and horses located at suitable points may be replaced by artificial bodies covering steel observation points. In all such cases service of the camouflage section should be called upon.

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